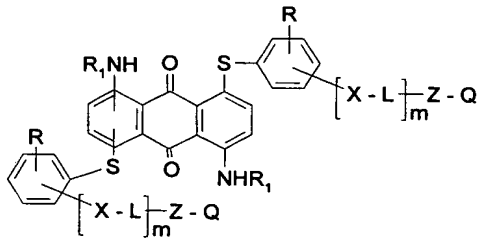
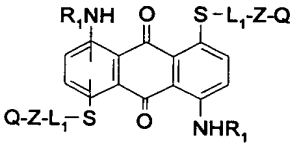
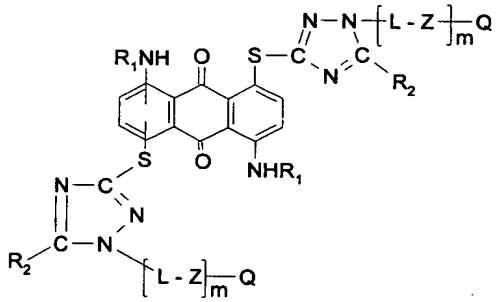
CLAIMS

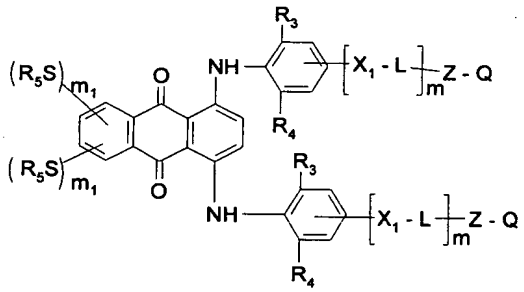
We claim:

1. Anthraquinone dye compounds having the formulae:

I. 

II. 

III. 

IV. 

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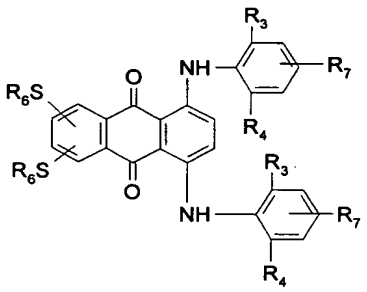

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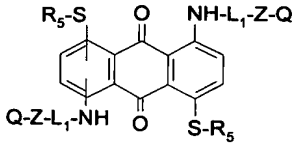
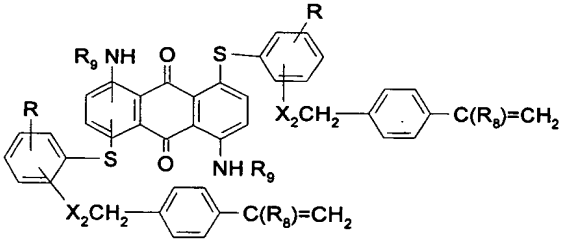
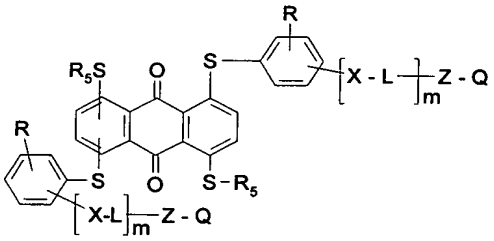


VII.



VIII.



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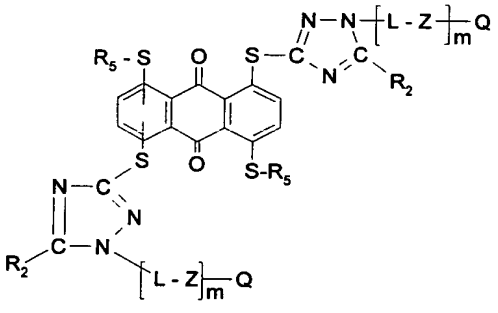
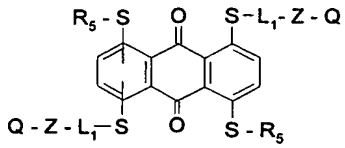
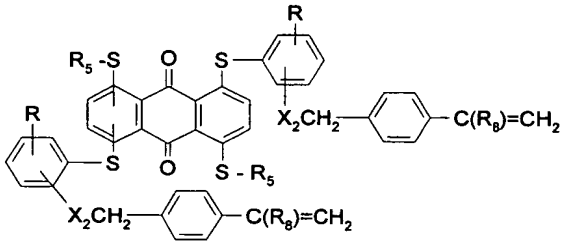


X.



XI.



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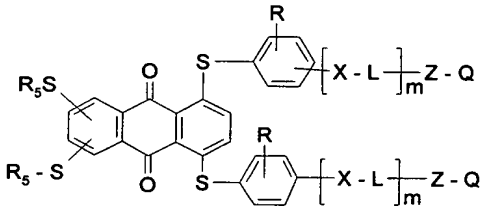

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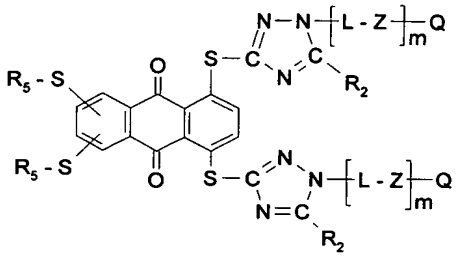

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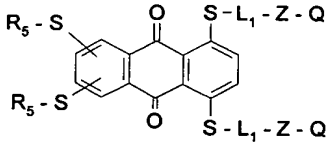
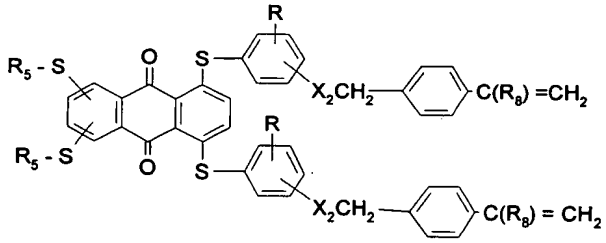
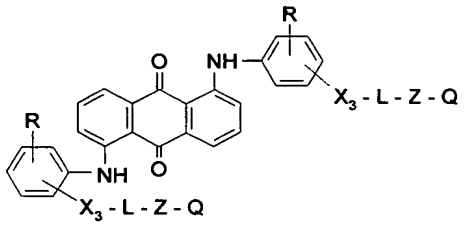


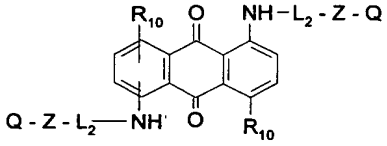
XV.



XVI.



XVII.



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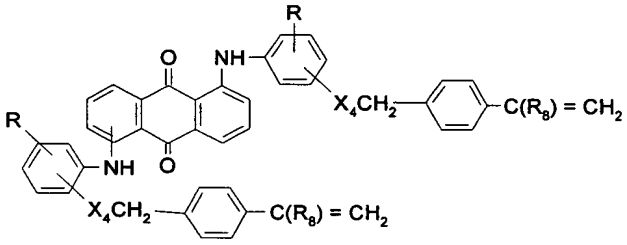

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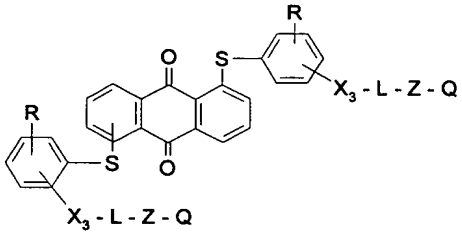
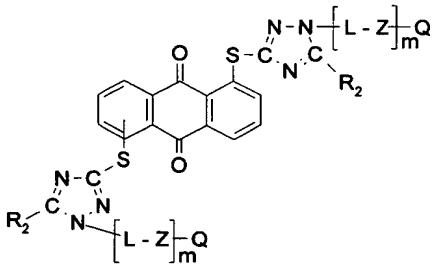
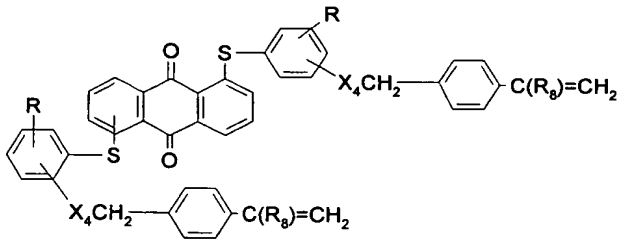


XX.



5

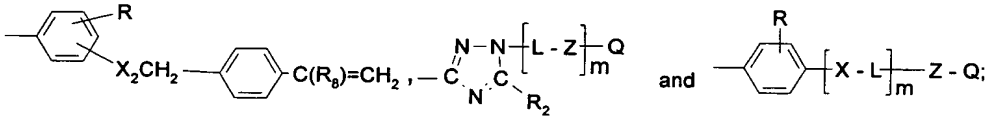
XXI. 

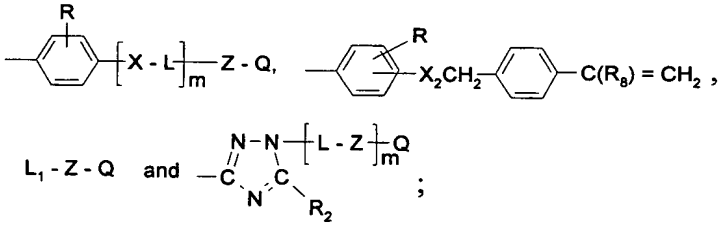
wherein:

R is selected from hydrogen or 1-3 groups selected from C_1 - C_6-alkyl, C_1 - C_6-alkoxy and halogen;

R_1 is selected from C_1 - C_6-alkyl, substituted C_1 - C_6-alkyl, C_3 - C_8-alkenyl, C_3 - C_8-cycloalkyl, aryl and -L_1-Z-Q; R_2 = selected from hydrogen, C_1 - C_6-alkyl, substituted C_1 - C_6-alkyl, C_3 - C_8-cycloalkyl and aryl;

R_3 and R_4 are independently selected from C_1 - C_6-alkyl and bromine;

R_5 is selected from C_1 - C_6-alkyl, substituted C_1 - C_6 alkyl, C_3 - C_8-cycloalkyl, aryl, heteroaryl, -L_1-Z-Q, 

R_6 is selected from 

R_7 is selected from hydrogen, substituted or unsubstituted C_1 - C_6-alkyl, C_1 - C_6-alkoxy, halogen, hydroxy, substituted or unsubstituted C_1 - C_6-alkylthio, sulfamoyl and substituted sulfamoyl;

R_8 is selected from hydrogen and C_1 - C_6-alkyl;

R_9 is selected from the groups represented by R_1 and -L - Z - Q;

R_{10} is selected from hydrogen and halogen;

X is a covalent bond or a divalent linking group selected from -O-, -S-, $-SO_2-$, $-CO_2-$, -CON(Y) - and $-SO_2N(Y)-$, wherein Y is selected from hydrogen, C_1- C_6-alkyl, substituted C_1-C_6-alkyl, C_3-C_8-cycloalkyl, C_3-C_8-alkenyl, aryl and -L-Z- Q;

X_1 is selected from -O-, -S-, $-SO_2-$ and $-SO_2N(Y)-$;

X_2 is selected from $-CO_2$ - and $-SO_2N(Y_1)$, wherein Y_1 is a group selected from hydrogen, C_1-C_6-alkyl, substituted C_1-C_6-alkyl, C_3-C_8-alkenyl, C_3-C_8-cycloalkyl, aryl, heteroaryl and $-CH_2$-p-C_6H_4-$C(R_8)=CH_2$;

X_3 is selected from $-CO_2-$, $-SO_2N(Y)-$;

X_4 is selected from $-CO_2-$, -O- and $-SO_2N(Y_1)-$;

L is a divalent linking group selected from C_1-C_8-alkylene, C_1-C_6-alkylene-arylene, arylene, C_1-C_6-alkylene-arylene -C_1-C_6-alkylene, C_3-C_8-cycloalkylene, C_1-C_6-alkylene -C_3-C_8-cycloalkylene -C_1-C_6-alkylene, C_1-C_6-alkylene - Z_1-arylene $-Z_1$-C_1-C_6-alkylene and C_2-C_6-alkylene-$[-Z_1$-C_2-C_6-alkylene-$]_n$- wherein Z_1 is selected from -O-, -S- and $-SO_2-$ and n is 1-3;

L_1 is a divalent linking group selected from C_2 - C_6-alkylene, C_1-C_6-alkylene-C_3-C_8-cycloalkylene-C_1-C_6-alkylene, C_1-C_6-alkylene-arylene, C_3-C_8-cycloalkylene, and C_2-C_6-alkylene-$[-Z_1$-C_2-C_6-alkylene-$]_n$-;

L_2 is selected from C_2-C_6-alkylene, C_1-C_6-alkylene- arylene-C_1-C_6 alkylene and C_1-C_6-alkylene-C_3-C_8-cycloalkylene-C_1-C_6-alkylene;

Z is a divalent group selected from -O-, -S-, -NH-, -N(C_1-C_6-alkyl)-, -N(C_3-C_8 alkenyl)-, -N(C_3-C_8 cycloalkyl)-, -N(aryl)-, -N(SO_2C_1-C_6-alkyl) and -N(SO_2 aryl)-, provided that when Q is a photopolymerizable optionally substituted maleimide radical, Z represents a covalent bond; Q is an ethylenically-unsaturated, photosensitive polymerizable group; and

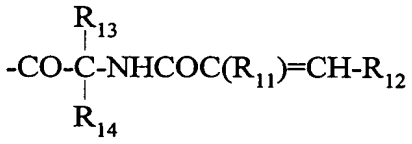
m and m_1 each is 0 or 1.

2. Anthraquinone compounds according to Claim 1 wherein the ethylenically-unsaturated, photosensitive copolymerizable groups represented by Q are selected from the following organic radicals:

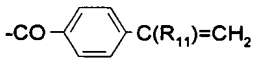
Ia $-COC(R_{11})=CH-R_{12}$

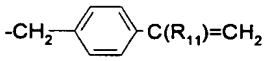
IIa $-CONH-COC(R_{11})=CH-R_{12}$

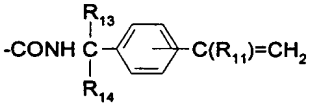
IIIa $-CONH-C_1$ - C_6-alkylene $OCOC(R_{11})$ $-CH=CH-R_{12}$

IVa 

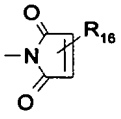
Va $-COCH=CH-CO_2R_{15}$

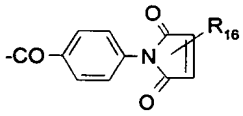
VIa 

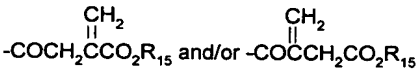
VIIa 

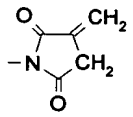
VIIIa 

IXa $-SO_2C(R_{11})=CH_2$

Xa  And

XIa 

XIIa 

XIIIa 

wherein:

R_{11} is selected from hydrogen and C_1-C_6-alkyl;

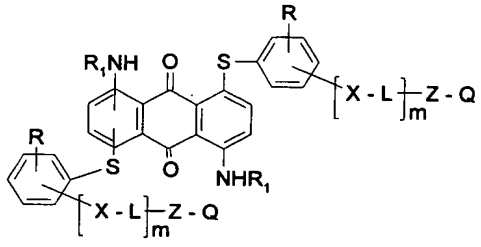
R_{12} is selected from hydrogen; C_1-C_6-alkyl; phenyl and phenyl substituted with one or more groups selected from C_1-C_6-alkyl, C_1-C_6-alkoxy, -N(C_1-C_6-alkyl), nitro, cyano, C_1-C_6-alkoxycarbonyl, C_1-C_6-alkanoyloxy and halogen; 1- and 2-naphthyl which may be substituted with C_1-C_6-alkyl or C_1-C_6-alkoxy; 2- and 3-thienyl which may be substituted with C_1-C_6-alkyl or halogen; 2- or 3-furyl which may be substituted with C_1-C_6-alkyl;

R_{13} and R_{14} are selected from hydrogen, C_1-C_6-alkyl, substituted C_1-C_6-alkyl, aryl or may be combined to represent a $-[-CH_2-]_{3-5}-$ radical;

R_{15} is selected from hydrogen, C_1-C_6-alkyl, substituted C_1-C_6-alkyl, C_3-C_8-alkenyl, C_3-C_8-cycloalkyl and aryl;

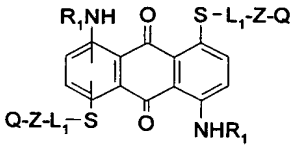
R_{16} is selected from hydrogen, C_1 - C_6-alkyl and aryl.

3. Anthraquinone compounds according to Claim 2 having the formula:

I. 

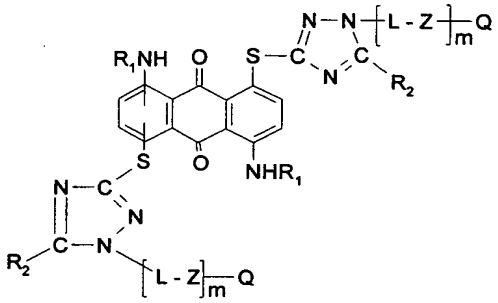
wherein Z is –O-.

4. Anthraquinone compounds according to Claim 2 having the formula:

II. 

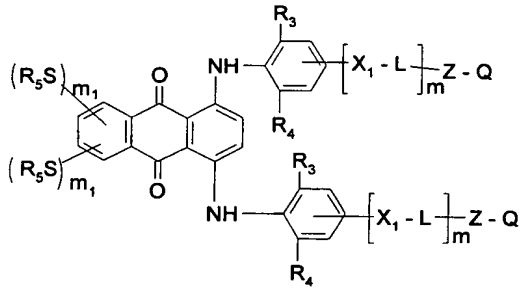
wherein Z is –O-.

5. Anthraquinone compounds according to Claim 2 having the formula:

III. 

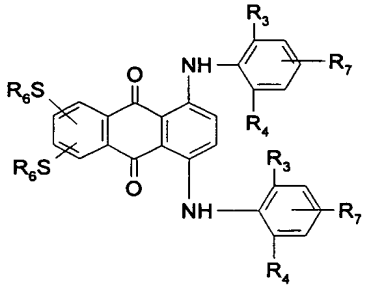
wherein Z is –O-.

6. Anthraquinone compounds according to Claim 2 having the formula:

IV. 

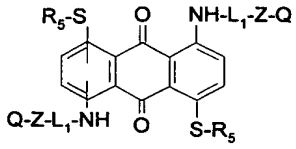
wherein Z is –O-.

7. Anthraquinone compounds according to Claim 2 having the formula:

V. 

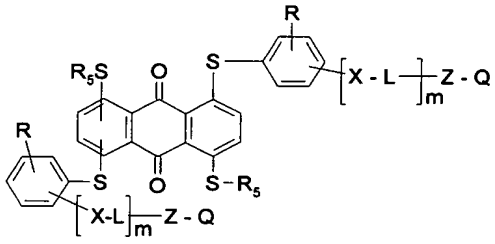
wherein Z is –O-.

8. Anthraquinone compounds according to Claim 2 having the formula:

VI. 

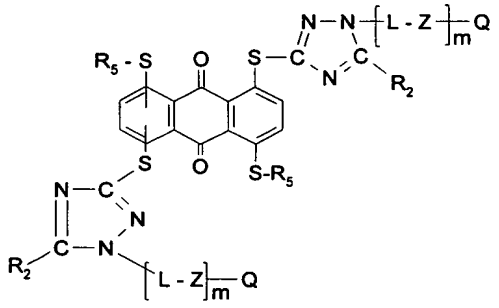
wherein Z is –O-.

9. Anthraquinone compounds according to Claim 2 having the formula:

VIII. 

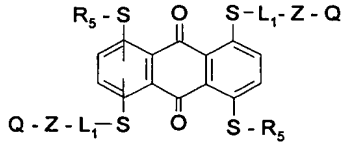
wherein Z is –O-.

10. Anthraquinone compounds according to Claim 2 having the formula:

IX. 

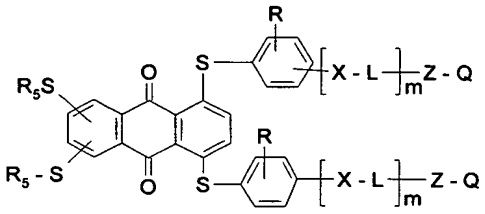
wherein Z is –O-.

11. Anthraquinone compounds according to Claim 2 having the formula:

X. 

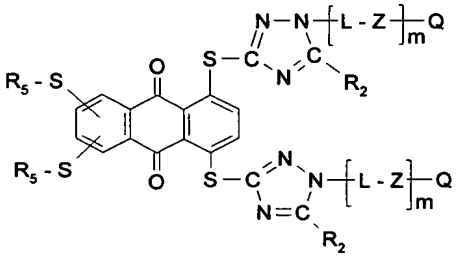
wherein Z is –O-.

12. Anthraquinone compounds according to Claim 2 having the formula:

XII. 

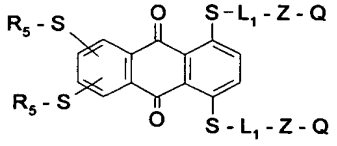
wherein Z is –O-.

13. Anthraquinone compounds according to Claim 2 having the formula:

XIII. 

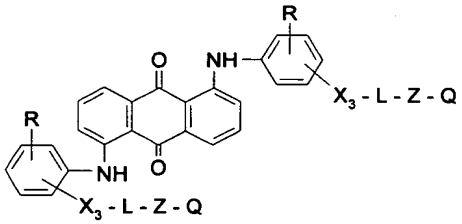
wherein Z is –O-.

14. Anthraquinone compounds according to Claim 2 having the formula:

XIV. 

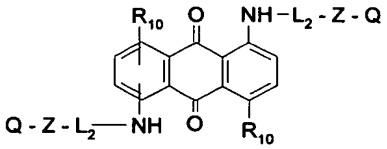
wherein Z is –O-.

15. Anthraquinone compounds according to Claim 2 having the formula:

XVI. 

wherein Z is –O-.

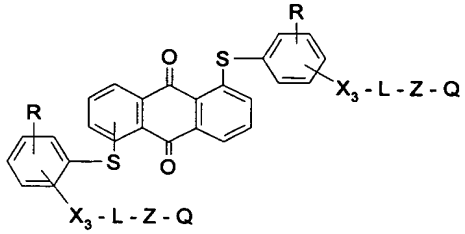
16. Anthraquinone compounds according to Claim 2 having the formula:

XVII. 

wherein Z is –O-.

17. Anthraquinone compounds according to Claim 2 having the formula:

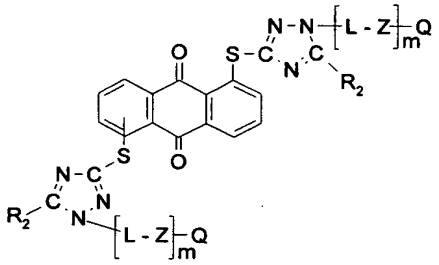
XIX.



wherein Z is –O-.

18. Anthraquinone compounds according to Claim 2 having the formula:

XX.



wherein Z is –O-.

19. Anthraquinone compounds according to Claim 2 wherein Q is organic radical Ia.

20. Anthraquinone compounds according to Claim 2 wherein Q is organic radical Ia wherein R_{11} is hydrogen or methyl and R_{12} is hydrogen.

21. Anthraquinone compounds according to Claim 2 wherein Q is organic radical VIIa.

22. Anthraquinone compounds according to Claim 2 wherein Q is organic radical VIIa wherein R_{11} is hydrogen.

23. Anthraquinone compounds according to Claim 2 wherein Q is organic radical VIIIa.

24. Anthraquinone compounds according to Claim 2 wherein Q is organic radical VIIIa wherein R_{11} is hydrogen or methyl and R_{13} and R_{14} are methyl. .

25. Anthraquinone compounds according to Claim 3 wherein X is $-CO_2-$, L is $-CH_2CH_2-$, and m is 1.

26. Anthraquinone compounds according to Claim 5 wherein L is $-CH_2CH_2-$, m is 1, and R_2 is hydrogen.

27. Anthraquinone compounds according to Claim 8 wherein L_1 is $-CH_2C(CH_3)_2CH_2-$ and R_5 is aryl.

28. Anthraquinone compounds according to Claim 9 wherein X is $-CO_2-$, L is $-CH_2CH_2-$, and m is 1.

29. Anthraquinone compounds according to Claim 10 wherein L is $-CH_2CH_2-$, R_2 is hydrogen and m is 1.

30. Anthraquinone compounds according to Claim 12 wherein X is $-CO_2-$, L is $-CH_2CH_2-$, and m is 1.

31. Anthraquinone compounds according to Claim 13 wherein L is $-CH_2CH_2-$, R_2 is hydrogen and m is 1.

32. Anthraquinone compounds according to Claim 15 wherein X_3 is $-CO_2-$, L is $-CH_2CH_2-$, and R is hydrogen or bromine.

33. Anthraquinone compounds according to Claim 15 wherein X_3 is $-CO_2-$, L is propylene, 1,4-cyclohexylenedimethylene or 2,2-dimethyltrimethylene, R is hydrogen, Z is –O-, and Q is an organic radical having the structure $-COC(R_{11})=CH_2$ wherein R_{11} is hydrogen, methyl or ethyl.

34. Anthraquinone compounds according to Claim 15 wherein X_3 is $-CO_2-$, L is propylene, 1,4-cyclohexylenedimethylene or 2,2-dimethyltrimethylene, R is hydrogen, Z is –O-, and Q is an organic radical having structure VIIIa wherein R_{11}, R_{13} and R_{14} each is methyl.

35. Anthraquinone compounds according to Claim 16 wherein L_2 is $-CH_2C(CH_3)_2CH_2-$, and R_{10} is hydrogen.

36. Anthraquinone compounds according to Claim 17 wherein X_3 is $-CO_2-$, L is $-CH_2CH_2-$, and R is hydrogen.

37. Anthraquinone compounds according to Claim 17 wherein X_3 is $-CO_2-$, L is propylene, 1,4-cyclohexylenedimethylene or 2,2-dimethyltrimethylene, R is hydrogen, Z is –O-, and Q is an organic radical having the structure $-COC(R_{11})=CH_2$ wherein R_{11} is hydrogen, methyl or ethyl.

38. Anthraquinone compounds according to Claim 17 wherein X_3 is $-CO_2-$, L is propylene, 1,4-cyclohexylenedimethylene or 2,2-dimethyltrimethylene, R is hydrogen, Z is –O-, and Q is an organic radical having structure VIIIa wherein R_{11}, R_{13} and R_{14} each is methyl.

39. Anthraquinone compounds according to Claim 18 wherein L is $-CH_2CH_2-$, R_2 is hydrogen, and m is 1.

40. Anthraquinone compounds according to Claim 6 wherein X is $-SO_2N(Y)-$, L is C_2-C_6 alkylene, R_3 and R_4 are methyl or ethyl, Y is hydrogen, m is 1 and m_1 is 0.

41. Anthraquinone compounds according to Claim 6 wherein X is $-SO_2N(Y)-$, L is C_2-C_6 alkylene, R_3 and R_4 are methyl or ethyl, Y is hydrogen, m is 1 and m_1 is 1.

42. Anthraquinone compounds according to Claim 1 having formula VII wherein X_2 is -CO2- and R and R_8 are hydrogen.

43. Anthraquinone compounds according to Claim 1 having formula XI wherein X_2 is -CO2- and R_1 and R_8 are hydrogen.

44. Anthraquinone compounds according to Claim 1 having formula XVII wherein X_4 is -CO2- and R and R_8 are hydrogen.

45. Anthraquinone compounds according to Claim 1 having formula XXI wherein X_4 is -CO2- and R and R_8 are hydrogen.

46. Anthraquinone compounds according to Claim 1 having formula IV wherein X_1 is -O-, Z is -O-, L is $-CH_2CH_2-$, R_3 and R_4 are methyl or ethyl, m is 1 and m_1 is 0.

47. A coating composition comprising (i) one or more polymerizable vinyl compounds, (ii) one or more of the dye compounds of Claim 1, and (iii) a photoinitiator.

48. A coating composition according to Claim 47 comprising (i) one or more polymerizable vinyl compounds, (ii) one or more of the dye compounds of Claim 2

present in a concentration of about 0.05 to 15 weight percent based on the weight of component (i), and (iii) a photoinitiator present in a concentration of about 1 to 15 weight percent based on the weight of the polymerizable vinyl compound(s) present in the coating composition.

49. A coating composition according to Claim 48 wherein the polymerizable vinyl compounds comprise a solution of a polymeric, polymerizable vinyl compound selected from acrylated and methacrylated polyesters, acrylated and methacrylated polyethers, acrylated and methacrylated epoxy polymers , acrylated or methacrylated urethanes, and mixtures thereof, in a diluent selected from monomeric acrylate and methacrylate esters.

50. A polymeric coating composition comprising a polymer of one or more acrylic acid esters, one or more methacrylic acid esters and/or other copolymerizable vinyl compounds, having copolymerized therein one or more of the dye compounds defined in Claim 1.

51. A polymeric composition according to Claim 50 comprising a coating of an acrylic polymer of one or more acrylic acid esters, one or more methacrylic acid esters or a mixture thereof having copolymerized therein one or more of the dye compounds defined in Claim 2.

52. A polymeric composition according to Claim 50 comprising a coating of an unsaturated polyester containing one or more maleate/fumarate residues; one or more monomers which contain one or more vinyl ether groups, one or more vinyl ester groups, or a combination thereof, and, optionally, one or more acrylic or methacrylic acid esters; or a mixture thereof having copolymerized therein one or more of the dye compounds defined in Claim 2.

53. A polymeric coating according to Claim 51 containing from about 0.05 to 15.0 weight percent of the residue of one or more of the dye compounds of Claim 2 based on the weight of the coating.

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